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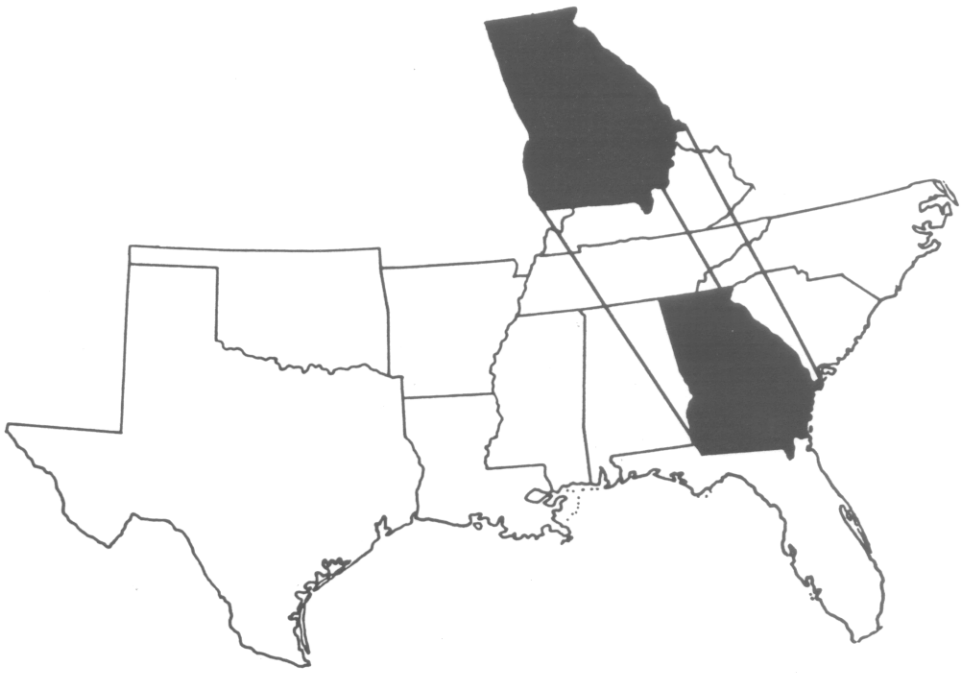
MECHANICAL WEED CONTROL For The Forest Nursery

By David South



About The Author

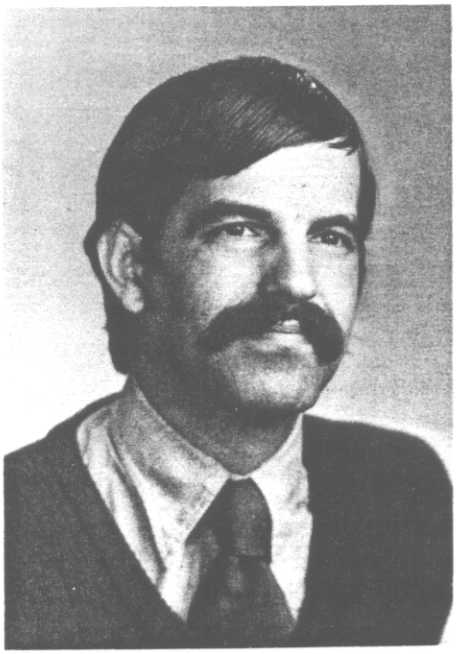


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Figure 1. Cultivation of redbud seedlings with the Fobro multiple-row brush hoe.

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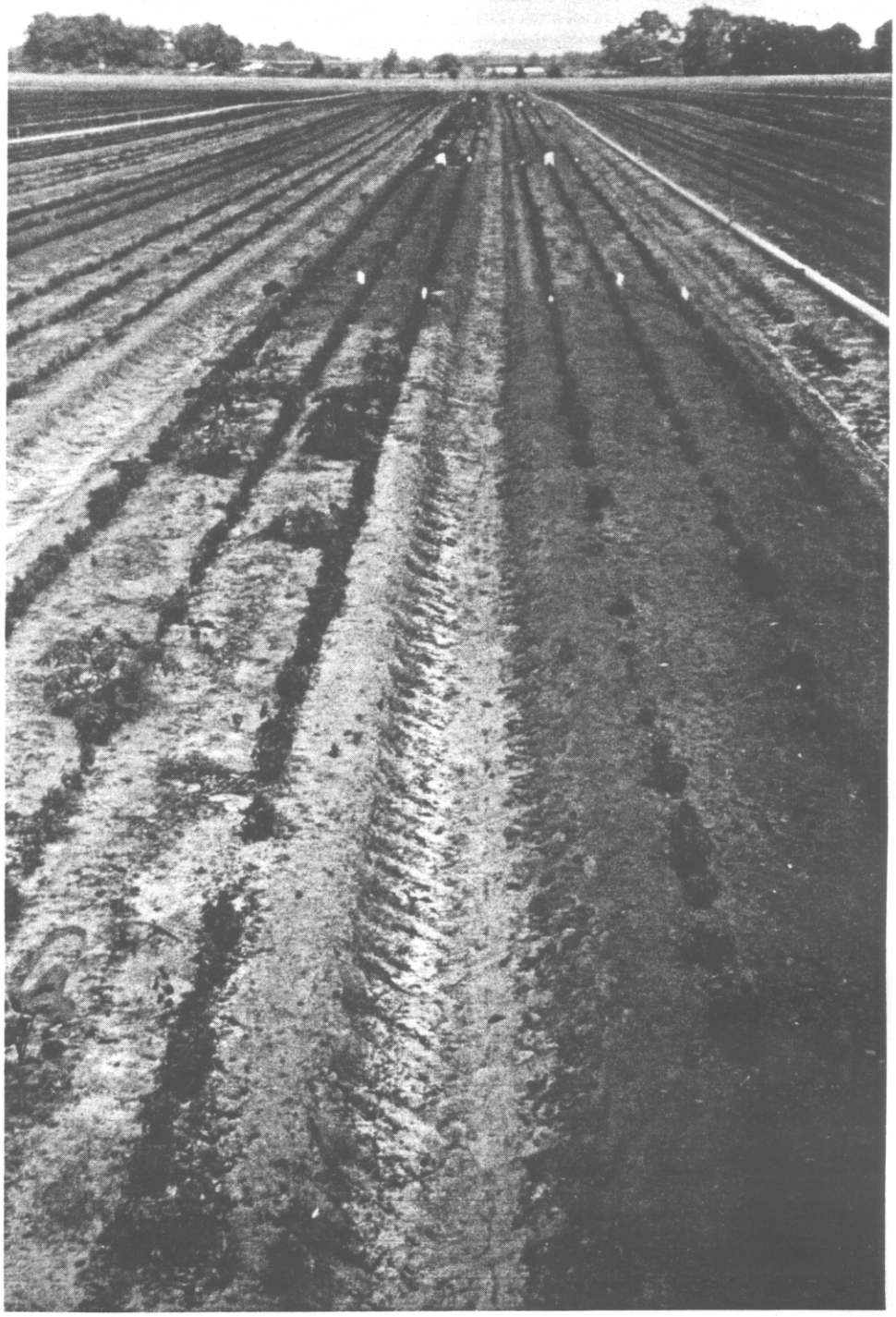

Figure 2. Overview of the red maple test.

Weed control studies with the fobro® multiple-row brush hoe were conducted in pine and hardwood seedbeds at the Morgan Nursery at Byron, Georgia. In hardwood seedbeds, three cultivations with the brush hoe reduced hand weeding requirements by 27 to 40 percent. However, use of effective herbicides in pine seedbeds provided better weed control than two or three cultivations with the brush hoe. When used in combination with herbicides, the brush hoe reduced the population of weeds not controlled by the herbicides. To avoid mortality and reduce injury to seedlings, cultivations should be delayed until the seedlings are large enough to withstand soil splash and root injury.

INTRODUCTION

Philip Wakeley (1954) made the following statements regarding mechanical cultivation in southern forest nurseries.

"Depending on seedling age and row spacing, 30 to 50 percent of the surface of drill-sown beds can be freed from weeds, at the time weeding is most needed, by means of narrow-bladed hoes or mechanical cultivators. Many millions of southern pine seedlings have been weeded mechanically with more or less satisfactory results (Cossitt 1938; McComb and Steavenson 1936; Toumey and Korstian 1942; Umland 1946). Mechanical cultivators have reduced total weeding costs by as much as 40 percent (Umland 1946), even though they have had to be supplemented by hand weeding close to and within the rows. Cultivation must be very shallow to avoid injuring seedling roots. The chief drawbacks of mechanical cultivation have been destruction of seedlings at or outside the margins of the rows, mechanical injury to and possible *Sclerotium* infection of surviving seedlings, and lodging of soil against or on seedlings, especially longleaf, with attendant damping-off. These difficulties have been reduced greatly by using improved cultivator shoes that slice just under the soil surface instead of raking it, and that have sideguards to keep loose dirt away from the seedlings."

With increased use of herbicides in pine seedbeds, the use of mechanical weed control rapidly declined in the South. Currently, nurseries in the South do not use mechanical weed control in pine seedbeds. However, mechanical weed control in conifer seedbeds is used on a limited basis in some nurseries in the Northwest (Owston and Abrahamson 1984). Recently, a new mechanical cultivator was developed in Europe for use in conifer nurseries (Fobro® multiple-row brush hoe, manufactured by Baertschi and Co. Ltd., Switzerland). Two models of this cultivator were made available for testing by the Georgia Forestry Commission. These models were tested to determine the utility of mechanically weeding 1-0 seedbeds in the South.

MATERIALS AND METHODS

All studies were conducted at the Georgia Forestry Commission's nursery near Byron, Georgia. A Faceville fine sandy loam soil is present at this nursery. Two models of the brush hoe were tested. A tall brush model configured to cultivate three 18-inch drills was used for the hardwoods (Figure 1). A smaller brush model was used for the pine seedbeds, and was set up for eight 6-inch drills.

Study 1 - Weed control in hardwood seedbeds

The brush hoe was tested in red maple (*Acer rubrum* L.) and eastern redbud (*Cercis canadensis* L.) seedbeds. Treatments tested were: (1) handweeding only; (2) three brushing with no trifluralin; (3) trifluralin after sowing and no brushing; and (4) trifluralin after sowing followed by three brushings. All treatments were replicated four times. Plot size for the treatments was 60 x 4 feet for the red maple test (Figure 2) and 40 x 4 feet for the redbud test. Prior to sowing, the experimental areas were fumigated with methyl bromide (with 33 percent chloropicrin) at a rate of 450 lb/acre. Seed were sown on 1-2 March, 1985. The hardwood seed were sown in three drills per bed with 18 inches between drills. After sowing, the area was mulched with sawdust and trifluralin at 1 pound active ingredient per acre (lb ai/acre) was applied to the herbicide plots. Irrigation followed the herbicide application to help reduce loss from volatility. All cultivated plots were brushed on 24 May, 19 June, and 8 July, 1985. All plots were handweeded following cultivation. The number of red maple seedlings per plot (with heights exceeding 20 inches) were recorded on 20 January, 1986.

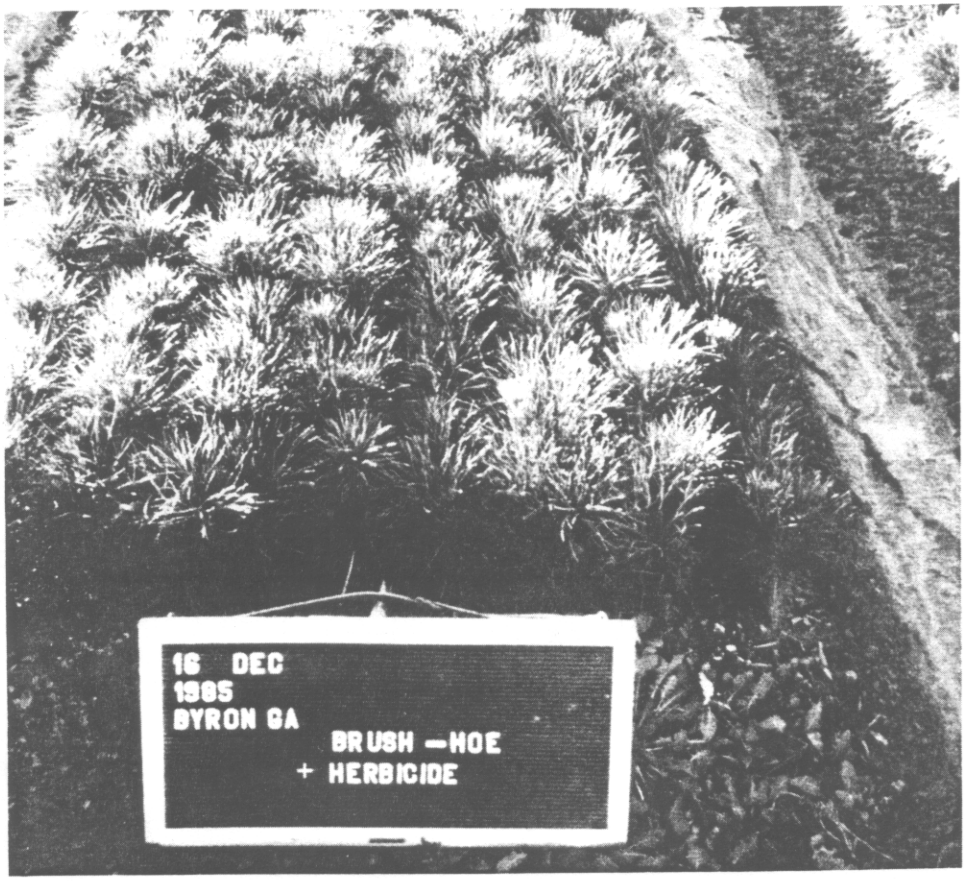

Figure 3. Lowest weeding times resulted from using both herbicides and mechanical cultivation.

Study 2 - Early-season weed control in pine seedbeds

A study was installed in loblolly pine (*Pinus taeda* L.) seedbeds to compare mechanical weed control with postemergence applications of the herbicide oxyfluorfen. The mechanical weed control treatment involved a preemergence application of 0.4 lb ai/acre of oxyfluorfen followed by three cultivations with the brush hoe. The cultivations were made on 21 May, 29 May, and 4 June, 1986. The comparison treatment included the same preemergence application of oxyflurofen followed by frequent postemergence applications of oxyfluorfen. Both treatment regimes were replicated four times. Grasses were controlled on both treatments with the herbicide sethoxydim. Plot size for the treatments was 400 by 18 feet. The experimental area was not fumigated prior to sowing. The area was sown on 16-17 April, 1986 and was mulched with pine bark. After sowing and mulching, oxyfluorfen at 0.5 lb ai/acre was applied to the herbicide plots. Handweeding times were recorded on 22 May, 10 June, 23 June, 9 July, 22 July, 5 August, and 2 September, 1986. Seedling counts were recorded on 9 July, 1986. Seedlings in the study area were stunted due to severe nematode problem and therefore plantable seedlings and fresh weights were not measured.

Study 3 - Late-season weed control in pine seedbeds

A late season study with the Fobro Brush-Hoe was conducted in slash pine (*Pinus elliottii* Engelm. var. elliottii) seedbeds. Treatments were imposed on operational seedbeds which had received several applications of herbicides. Treatments applied after 4 July, 1985 included: (1) handweeding only; (2) two brushings with no oxyfluorfen; (3) four post-emergence applications of oxyfluorfen and no brushings; and (4) four post-emergence applications of oxyfluorfen and two brushings. All treatments applied after 4 July were replicated four times. Oxyfluorfen (0.15 lb ai/acre) was applied to herbicide plots on July 12, 18, 25 and on August 29. Plot size for the treatments was 500 by 6 feet. Prior to sowing the experimental area was fumigated with methyl bromide (with 33 percent chloropicrin) at a rate of 450 lb/acre. The area was sown on 17 April, 1985 and mulched was sown on 17 April, 1985 and mulched with pine bark. Seeds were sown in drills six inches apart. After sowing, 0.5 lb ai/acre oxyfluorfen was applied to all plots. The area was also treated with 0.19 lb ai/acre sethoxydim on 11 May and 0.15 lb ai/acre oxyfluorfen on 17 June and 24 June. Cultivated plots were brushed on 5 July and 6 August, 1985. Seedlings were sampled on 20 January, 1986.

RESULTS AND DISCUSSION

Weed Control

Weeding times for the studies are presented in Tables 1-4. Three cultivations with the brush hoe reduced total weeding times in hardwood seedbeds from 27 percent (Table 1) to 40 percent (Table 2). Weed control with the brush hoe was better than with a single preemergence application of trifluralin. Weeding times were lowest when cultivation followed the herbicide application.

In slash pine seedbeds previously treated with several applications of oxyfluorfen, two cultivations with the brush hoe(in July and August) did not significantly reduce hand weeding times in August (Table 3). However, the weeding times were lowest when the brush hoe was used in combination with applications of oxyfluorfen (Figure 3). In loblolly pine seedbeds, three cultivations (before the middle of June) did not control weeds in June as well as weekly applications of oxyfluorfen (Table 4).

Cultivation can lower the population of sicklepod (*Cassia obtusifolia* L.) and flathead sedge (*Cyperus Compressus* L.) (Table 5). Counts taken in loblolly pine seedbeds in July indicated a 70 percent reduction in the number of spurge (*Euphobis spp.*) with a single cultivation with the brush hoe. Sickilepod and spurge are often hard to control in seedbeds with commonly used herbicides.

A disadvantage of the brush hoe is that weeds growing within drill rows do not come in contact with the brushes. Control

Table 1. Weeding times for red maple seedbeds.

Treatment	May	June	July	Total
	(hours per acre)			
control	7.7 a	5.5 a	9.9 a	23.1 a
trifluralin	6.8 a	4.6 ab	7.8 a	19.2 a
brush hoe	4.3 b	5.0 a	7.5 a	16.8 ab
brush hoe + trifluralin	4.2 b	3.2 b	3.9 a	7.5 b

Within-column means followed by the same letter are not significantly different at the 0.05 level of probability (Duncan's New Multiple Range Test).

Table 2. Weeding times for redbud seedbeds.

Treatment	May	June	July	Total
	(hours per acre)			
control	9.8 a	3.1 a	8.5 a	21.4 a
trifluralin	9.1 a	3.4 a	10.1 a	22.6 a
brush hoe	5.2 bc	3.1 a	4.7 b	13.0 b
brush hoe + trifluralin	4.0 c	1.5 a	4.3 b	9.8 b

Within-column means followed by the same letter are not significantly different at the 0.05 level of probability (Duncan's New Multiple Range Test).

Table 3. Weeding times for loblolly pine seedbeds.

Treatment	May	June	July	August	September	Total
	(hours per acre)					
brush hoe	7.0 a	24.4 a	19.0 a	11.7 a	44.2 a	106.3 a
oxyfluorfen	6.7 a	9.3 b	8.6 b	4.5 b	4.9 b	34.0 b

Within-column means followed by the same letter are not significantly different at the 0.05 level of probability (Duncan's New Multiple Range Test).

Table 4. Seedling production and weeding times for slash pine seedbeds.

Treatment	Fresh weight (g)	Plantables (#)	Culls (#)	Total (#)	Weeding time August 15
	(per square foot)				(hours/acre)
control	519 a	28.6 a	0.8 a	29.4 a	4.0 a
oxyfluorfen	519 a	28.9 a	1.8 a	30.7 a	2.8 bc
brush hoe	507 a	26.4 a	1.1 a	27.5 a	3.6 ab
brush hoe + oxfluorfen	509 a	30.5 a	1.0 a	31.5 a	2.4 c

Within-column means followed by the same letter are not significantly different at the 0.05 level of probability (Duncan's New Multiple Range Test).

of weeds within drill rows is dependent on soil (thrown from the action of the brushes) covering small weeds. Control of weeds within the drill becomes less effective when the weeds get too big to be buried by the soil.

The percentage of seedbed being brushed is dependent on the number of seed drills per bed. Therefore, more seedbed area was actually brushed for the hardwoods (with only three drills per bed) than in pines (with eight drills per bed). The percentage of brushed seedbed was 75 percent in the hardwoods and 56 percent in the pine seedbeds.

Timing is important to obtain good weed control with the brush hoe. The best weed control is obtained when weeds are small and germinating weeds within the drills can be buried with soil. This means that frequent cultivations are needed in order to obtain the best weed control with the brush hoe. Even cultivation on a monthly basis can allow a weed within the drill to grow to a size large enough to withstand cultivation. However, tree seedlings are also most susceptible to injury when they are small and less than three months old.

Tree Seedling Mortality

The amount of tree seedling mortality occurring from mechanical cultivation is dependent upon: (1) the skill of the operator; (2) the amount of tree seed germinating between drills; (3) a consistent spacing between drills; (4) the amount of root injury; and (5) seedling size. In general, the skill of the operator at the Morgan Nursery was good. A test conducted with loblolly pine on 5 July, 1985 indicated that initial loss of seedlings due to cultivation averaged only 0.25 percent per cultivation. Five passes with the cultivator reduced the seedling stand by 1.25 percent.

The amount of tree seed germinating between drills can depend on depth of sowing, rainfall after sowing, and type of sower. In 1985, there were a number of red maple seedlings growing between drills. The first cultivation in May reduced the population by 32 seedlings per 100 linear feet of seedbed. Fewer redbud

Table 5. Weed control in hardwood seedbeds.

	Red maple test		Redbud test	
Treatment	Sicklepod	Flathead sedge	Sicklepod	Flathead sedge
	(number per plot)			
control	10.2 a	1.5 a	13.7 ab	3.7 a
trifluralin	5.5 a	1.0 a	23.5 a	3.2 a
brush hoe	2.7 a	0.2 a	5.7 b	0.5 b
brush hoe + trifluralin	2.2 b	0.0 a	9.0 b	2.7 b

Within-column means followed by the same letter are not significantly different at the 0.05 level of probability (Duncan's New Multiple Range Test).

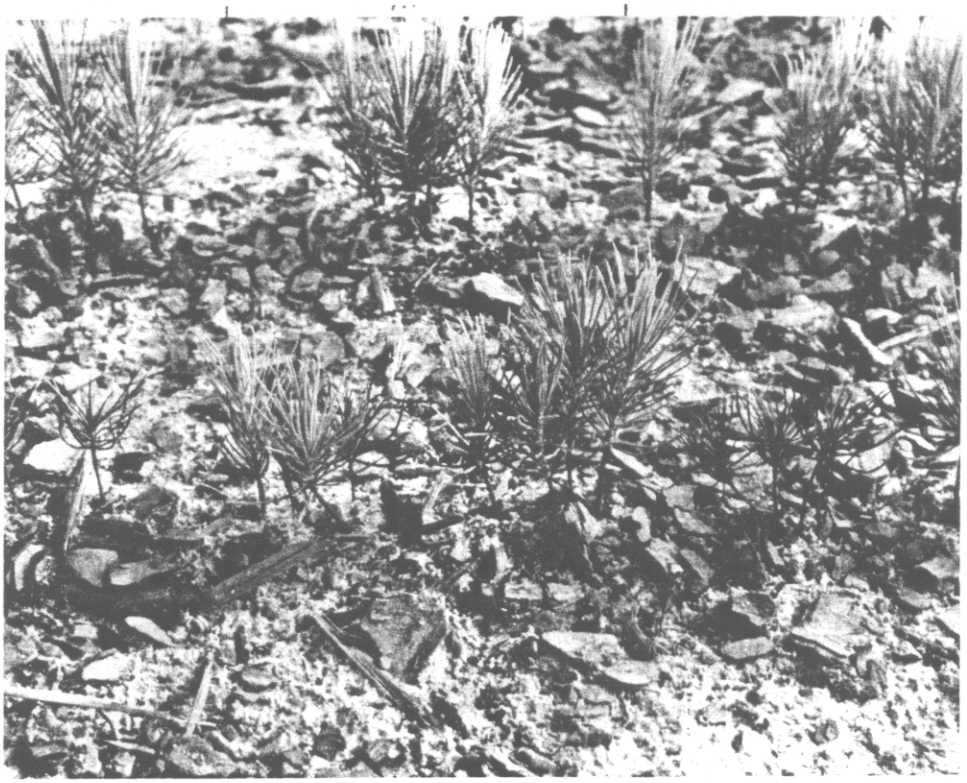

Figure 4. Damping-off due to injury from mechanical cultivation.

* * *

CONCLUSIONS

Mechanical weed control between seedling drills appeared more effective in hardwood seedbeds than in pine seedbeds. One explanation is that herbicides tested in hardwood seedbeds were less effective than those used on the pines. In addition, the brush hoe used in the hardwoods cultivates more area (75 percent) than the one used in pines (56 percent).

Seeding mortality resulting from cultivation decreases as seedling size increases. Some mortality is to be expected if cultivated seedlings are less than two months old. Therefore, for pine seedbeds, substituting handweeding and mechanical cultivation for use of effective preemergence and early postemergence herbicides will result in increased seedling mortality. However, once pine seedlings have otained a certain size, mechanical weed control can be safely used as an aid in controlling certain weeds that are resistant to herbicides.

seedlings were growing between drills and only 2.5 seedlings per 100 linear feet of bed were lost.

For the pines, the distance between seedling drills was usually consistent. Therefore, most of the operational pine beds could be brushed. However, the distance between hardwood drills varied and the cultivator could not be used on some of the operational beds.

Seedling roots can be severed if the brushes cultivate too deeply or too close to the drills. Injury to young roots under some circumstances may result in seedling death due to secondary infection of damping-off fungi. An increase in damping-off was observed in cultivated beds (Figure 4).

Tolerance of seedlings to cultivation is dependent on seedling size. When young redbud seedlings (12 weeks from sowing) were cultivated, seedling mortality within the drill was 8 percent. Mortality occurred in part due to soil covering small seedlings. As the seedlings grew taller, death due to soil covering was minimized. Young pine seedlings (5 weeks from sowing) were also injured with cultivations (Figure 5). In fact, cultivations in Study 2 were discontinued due to damage observed on young seedlings. Although not statistically different, seedling counts taken on plots cultivated in May and June were 8 percent lower than on plots treated with the herbicide oxyfloufen. This level of mortality could be an under estimation since sampling of seedlings was systematic (and injury often occurred in patches).

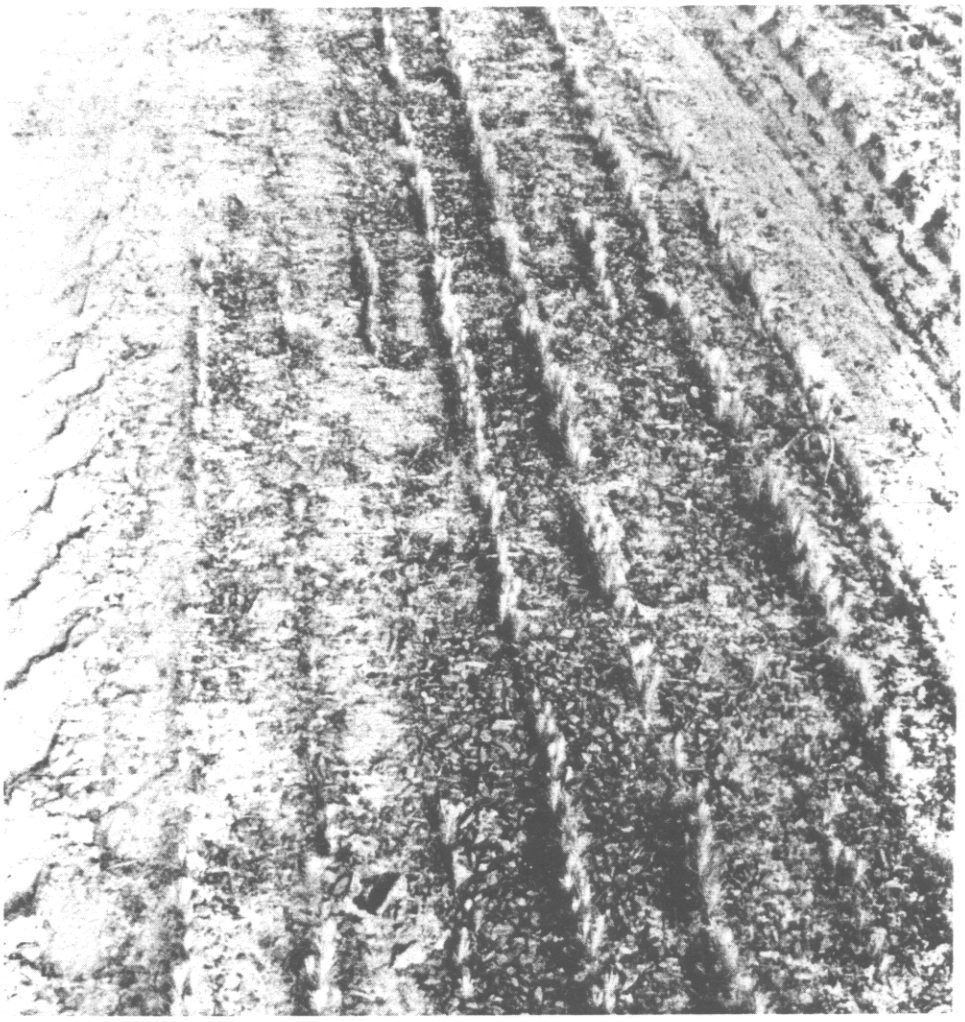

Figure 5. Stand reduction resulting from early mechanical cultivation.

LITERATURE CITED

Cossitt, F.M. 1938. Cultural practices in southern forest nurseries. U.S.D.A. Forest Service Region 8, 21 pp.

McComb, A. L. and H. A. Steavenson. 1936. Some new nursery equipment. J. For. 34:698-701.

Owston, P. W. and L. P. Abrahamson. 1984. Weed management in forest nurseries. *In*: Forest nursery manual: Production of bareroot seedlings (M. L. Duryea and T. D. Landis, eds.), p. 198-202. Martinus Nijhoff/Dr. W. Junk Publishers, The Hague/Boston/Lancaster. 386 pp.

Toumey, J. W. and C. F. Korstian. 1942. Seeding and planting in the practice of forestry. Ed. 3; Wiley, New York. 507 pp.

Umland, C. B. 1946. Nursery weeding costs reduced by mechanical cultivation. J. For. 44:379-380.

Wakeley, P. C. 1954. Planting the southern pines. U.S.D.A. Monogr. 18, 233 pp.

John W. Mixon, Director

Quantity: 500
Cost: $496.91